Third United Nations International Conference on the Peaceful Uses of Atomic Energy

A/CONF.28/A/809
SWEDEN
February 1964
Original: ENGLISH

Confidential until official release during Conference

Abstract

Design, Development and Manufacture of Control Rod Drives for Heavy Water Power Reactors

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The control rod drives of a nuclear reactor must be regarded as an auxiliary equipment and consequently their design must be adapted to the design of the complete core as optimized from an economic, heat transmission and reactor physics point of view. This leads to certain requirements with regard to location, space allowable etc. which it is the task of the designer to fulfil. On the other hand it might be impossible to satisfy the theoretically desired properties. Thus it is important that simultaneous and close collaboration is maintained during the design of the core and control rod drives.

In addition, for a control rod drive, the requirment for functional safety is extremely high. For heavy water reactors there is also the special problem due to health hazards in connection with the tritium content of the heavy water. This must be taken into account when planning for the exchange of drives in the reactor, for service work on the mechanisms etc.

In the paper a description is given of the experience which has been gained in the Swedish work on D_2O moderated and -cooled pressure vessel reactors, one being the Ågesta reactor, which is now in operation, and the other the Marviken reactor, which is in an advanced design stage and is due to be critical in 1968.

In both these reactors the absorber rods are tubular and the absorbing alloy, silver, indium and cadmium, is canned on the inside and outside with stainless steel. In the boundary region the absorbing alloy and the canning material

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are metallurgically bonded to each other. The development work and the manufacture of the control rods is dealt with in the paper.

The drive mechanisms are of the same principal design in Ågesta and Marviken. The differences in location and environment conditions, however, make a number of modifications necessary for Marviken. In the paper a description is given of the design of the drive mechanisms, of the results from the extensive development work which was performed for Ågesta and of the planned prototype tests for Marviken.

A number of special problems had to be solved, during the manufacture of the control rod drives for Ågesta. The most important of these as well as the first operational experience are touched upon in the paper.

Finally some conceivable types of control rod drives for developed heavy water power reactors are mentioned. One solution, to which a great deal of design and experimental work has been devoted, is a drive for location below the reactor core in the pressure vessel bottom. A short description of the work on this design is given.